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ABSTRACT

A study examined the views and experiences of a wide range of British individuals and organizations with a stake in the success of efforts to extend information technology programs to groups who have been traditionally underrepresented in them. A variety of research methods were used, including in-depth interviews, workshops, questionnaires, and a literature review. It was concluded that a formal statement of college policy is necessary to provide a framework within which all program development actions can be taken. The policy should address the needs of government, industry, education, and individuals. Similarly, the staff development strategy developed should apply to staff in all departments and at all levels. Efforts in the area of employer liaison should include the development of strategies to improve students' job prospects and help employers overcome bias against particular groups of employees. Links with schools also need to be fostered and maintained. Marketing is one of the key factors in increasing the participation of underrepresented groups in information technology programs. Preparatory, advisory, and follow-up work with learners is no less important to improving the prospects of nontraditional students. (Appendixes include a description of the research project conducted and a synopsis of the literature review.) (MN)

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Information technology and the wasted resource

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Information technology and the wasted resource

IT and under-represented learners

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Foreword

The report which follows distinguishes two main strands of Information Technology: as an aspect of technology, and as information management - sometimes called information systems management.

It is the latter area where IT has had a dramatic effect on most occupations, and will continue to generate occupational change for the foreseeable future.

The report is about:

- providing enough skilled workers to fulfil the requirements of industry and the community;
- ensuring that the style and content of education and training provision adjusts to this rapid occupational change;
- finding ways to attract more women into IT learning programmes, and making sure that they have every chance to succeed.

It should be of particular interest to:

- heads of college departments;
- senior managers with a brief which concerns institutional change;
- any college staff with an equal opportunities brief.

We hope you find the report interesting, and that you will keep us informed of any initiatives related to the area it covers or any attempts to test the ideas it contains.

FEU intends to produce a follow-up pack of materials aimed at assisting colleges to implement their work in this area more effectively. Please let us know if you are able to contribute ideas or examples which might assist in this work.

Elizabeth Simpson
Development Officer
FEU

1 Introduction

1 Further education has a basic and essential role to play in providing the skilled workforce Britain needs to keep up with the rapid expansion of information technology (IT). Close ties with industry and the ability to respond rapidly to the demands of local labour markets mean that further education is uniquely placed to make an impact on the shortfall in skilled IT personnel.

2 Public sector further and higher education already provides the majority of IT-skilled employees; the sector has been at the forefront of some important initiatives aimed at increasing IT provision. Much remains to be done, particularly to enhance the participation of people who are currently under-represented and (apparently) unmotivated, but who have much to contribute. Younger women are the most obvious group of such potential learners, with mature learners (of whom many are women) a close second.

3 This report considers some of the issues and problems of IT teaching and learning and examines some techniques and strategies which are seen to enhance the participation of under-represented groups in FE courses. It is presented in terms of the FEU curriculum development model, under the headings:

- Recommendations
- Values and needs
- Course design and implementation
- Evaluation and review
- Support

4 Guidelines for good practice, with illustrative examples, are given in *Recommendations*. Where appropriate, discussion throughout the report is related to three levels of FE provision, referred to as:

- basic - including YTS, 'Women into Technology', Access* courses
- intermediate - including BTEC HNC and degree foundation
- higher - including HND and degree level

Research

5 The report is based on an exploration of the views and experiences of a wide range of people and organisations involved in IT training and education, and the opinions and concerns of employers, unions and others who have a stake in its success.

6 The research consisted of:

- in-depth interviews
- workshops
- questionnaires
- literature review

7 A description of the interviews, workshops and questionnaires appears in Appendix A. A synopsis of the literature review is given in Appendix B. The literature review is available separately, on request from FEU.

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* The term 'access', meaning a form of basic provision, is used generically throughout this report.

Literature review

8 Since the literature review formed a starting-point for much of the subsequent research, some of the issues it raised are described here. It covered recent literature concerned with employment and IT, with particular reference to the education, training and employment of women.

9 It reveals widespread concern about the effects of IT in restructuring employment, and in particular its effects on women and jobs, which are seen to be largely negative. The severity of the existing skills shortfall is well documented, as is the failure of women and other groups to take advantage of opportunities in IT.

10 The review also provides a general description of work which has already been done to attract women and other under-represented groups to science and technology courses, and describes a number of important initiatives (many government sponsored) which have achieved positive results. There has been much discussion of course content, teaching methods and ways of attracting the under-represented into education and training. Some of the ideas and conclusions presented here are drawn from the literature search.

Definitions

11 Two terms require some discussion; they are:

- information technology
- unmotivated and under-represented learners

Information technology (IT)

12 The meaning of the term 'IT' is problematic. Definitions have some value; FEU supplies one of the most comprehensive, at least as far as the IT curriculum is concerned:

> *'the acquisition, production, transformation, storage and transmission of data by electronic means in forms such as vocal, pictorial, textural or numeric, so as to facilitate the interaction between people, and between people and machines. IT also includes the applications and implications (social, economic and cultural) of these processes.'*[1]

Even this omits aspects of IT such as graphic (e.g. on-screen design of buildings, cars, etc.) and interactive (e.g. programs linked to video for facilitating subject learning).

13 The complexity of definitions indicates the many uses of IT and the array of skills it demands. IT is not only a single occupation or subject of study, nor is it confined to the computing industry. It is a stimulus for new ways of working, for the application of new knowledge and technology to many different areas of our lives. It has already had a great impact on the way we work and communicate, and will bring many more changes as it becomes still more widespread.

14 It makes sense to distinguish two main strands of IT:

- as an aspect of technology
- as information management (IM) - sometimes called information systems management

15 IT as technology is an aspect of engineering, and includes information systems, electronics and software, 'telecoms', production, manufacturing and design. It also covers computer science. Recruitment and training issues in science and technology (e.g. the number of women) also apply.

16 Although there is still controversy about the number of jobs that will be created in these sectors, prospects for growth are good. A recent government report notes that, while employment may continue to decline, 'occupations in computing and microelectronics can be expected to grow'[2]. IT has created new manufacturing jobs developing, producing and linking the hardware, and there has been an even greater expansion in jobs in the software industry. Technological jobs in IT demand and use a wide range of skills - systems and design, software engineering, robotics, electronic and 'telecoms' engineering, technical authorship, education and training of end users, as well as research and development.

17 In addition, the anticipated growth in local area networks enables easier linking of microcomputers in small or large numbers and allows data transfer, and program and printer sharing. The multiple workstations available to many end users is expected to exacerbate the existing skills shortages in networking and communications systems. The expectation is that by 1991 over half of all micros will be connected[3]. Such networks, sometimes supported by massive file servers and processors, demand many levels of technical support staff.

Information management (IM)

18 This is the area where IT has had a dramatic effect in virtually all occupations. Here technology is subservient to applications. Users do not think of themselves as working with or in IT; rather they are making the most of equipment that exists to help them do their job efficiently. A recent report by

Planning project costs with the help of a spreadsheet program.

the National Computing Centre[4] suggests that there is growth in the demand for such **skilled end users** - people who are able to apply and adapt ready-made software to their own work context. The use of IT now extends into many different work areas:

- computer modelling helps designers, not just in engineering and manufacturing, but also in fashion, music and the graphic arts;
- financial modelling helps businesses develop strategies and monitor performance;

- office automation controlled by skilled people using sophisticated equipment improves efficiency and speed by mechanising routine tasks;
- there are applications in health care for disease detection and monitoring, as well as in nurse management;
- desktop publishing allows trained end users to produce their own literature, e.g. advertising;
- computerised stock control lets shopfloor employees record data directly into the system.

Skilled end users are needed everywhere.

19 Here, too, the growth in local area networks with multiple workstations will create a need for new staff, perhaps most importantly people who can manage the complex interplay of people, equipment and systems which such networks involve[5].

Under-represented learners

20 This term is used to describe the very large number of people who, for a variety of reasons, are not represented in IT-related subjects or 'anything technical'. By and large, they have not taken science, mathematics or technical options at school. A disproportionate number are female. Their existence is indicated by the fact that where efforts are made to attract them to IT courses, there is a significant degree of success[6]. This is also true in engineering, where WISE (Women in Science and Engineering) is regarded as being responsible for the record number of women now on engineering degree courses[7].

2 Recommendations

21 These recommendations are based on the practice of colleges which are addressing the issues, and on ideas expressed by committed and successful practitioners at the workshops. They cover:

- college policy
- staff development
- employer liaison
- school liaison
- marketing
- design, structure and implementation
- guidance, support and progression.

College policy

22 A formal statement of college policy is necessary to provide a framework within which the action required can be taken. Without such a policy, there is a danger that individuals and departments may go their own way, with no central co-ordination. A college policy for information technology and information management, agreed by the academic board, will focus on meeting the needs of government, industry, education and individuals. It should commit the college to:

- **identify IT and IM needs of local employers, and be aware of those of national employers;**
- **increase the numbers of under-represented groups on IT and IM courses;**
- **offer IT or IM modules to all relevant courses;**
- **incorporate teaching of IT into as many subject areas as possible;**
- **ensure training and development of all staff in IT and IM;**
- **collect information to support and develop the policy;**
- **appoint an equal opportunities officer;**
- **evaluate the success of the policy and respond to lessons learned.**

EXAMPLES

A London college

The policy commits the college to:

- **get more women to apply;**
- **take on as many as apply with minimum requirements;**
- **offer remedial alternatives to those without the minimum requirements;**
- **encourage students from a variety of ethnic backgrounds;**
- **offer creche facilities.**

A regional college of arts and technology

This has a policy of including a ten-hour module in IT in all first-year courses. The module is designed as a flexible framework to cover the most important aspects of IT, and to suit widely differing courses and student abilities. Some departments already have the necessary expertise to teach the module; others organise a special in-service staff training programme. Each department is encouraged to provide a tutor who is familiar with the students and their course.

Staff development

23 A staff development strategy should apply to staff in all departments and at all levels, and should seek to:

- **develop IT teachers whose initial training was in another subject;**
- **help other subject teachers introduce and use IT or IM;**
- **encourage female staff to work in IT;**
- **foster self-awareness in staff to address the problems of stereotyping by gender;**
- **help careers advisers and guidance tutors become aware of the range of opportunities available in IT and the importance of IM in all occupations;**
- **provide updating to ensure staff are aware of IT and IM developments;**
- **develop techniques for supporting participative, learner-centred approaches;**
- **make use of project management for learner support.**

EXAMPLE

In a polytechnic department of computer technology:

- department staff go on short or long courses to update skills;
- where possible they are released to attend exhibitions, seminars, user groups, etc. on computing, education or management;
- they train the rest of the staff with a commitment to ensure 'as a minimum' computer awareness and computer literacy in all college staff;
- they advise on college-wide specialisms such as computer-aided manufacture and design (CAD/CAM), and computer-assisted learning (CAL).

Employer liaison

24 Most colleges recognise the need to develop close links with employers; in the IT and IM area these links should seek to:

- **establish the needs of industry with regard to IT and IM;**
- **increase the relevance of particular courses for local employers, and so improve students' job prospects;**
- **establish useful and interesting work experience placements for students at all levels;**
- **help employers to overcome bias against particular groups of employees;**
- **establish an advisory committee to facilitate curriculum development.**

EXAMPLES

One LEA is developing an employer link project which:

- advises local smaller employers on how to computerise;
- in the light of this, identifies skill needs;
- provides specific training to meet these needs;
- invites employers into schools and colleges to show them the capabilities of students and staff.

Students in their third term at a London college:

- identify a project for a small local business;
- assess the requirements and design a practical system;
- install the system and train the staff to use it efficiently.

School liaison

25 Links with schools need to be fostered and maintained as part of the process of marketing IT and IM. This will include:

- **preparation or dissemination of suitable handouts and posters about the range of training and employment opportunities in IT and IM, aimed at students, parents, teachers and careers advisers;**
- **arranging for staff and students to visit schools;**
- **holding open days and evenings;**
- **arranging short introductory courses during school holidays;**
- **using role models (e.g. women technologists), for the benefit of parents as well as students.**

EXAMPLES

A college of further education had a general recruitment strategy which involved:

- **press releases describing successful women in IT;**
- **liaison with local schools, careers officers and libraries;**
- **the offer of updating courses for secretaries interested in IT;**
- **arrangement of taster courses for local schools.**

A college in South Wales:

- **contacts all women taking the TVEI computing and technology option;**
- **visits the schools with young women from their courses to talk to potential recruits and their parents.**

A careers adviser recommends that an FE college

- **arranges open days for schoolteachers, students and parents together;**
- **encourages use of computers with staff and students to help;**
- **also invites local employers and careers officers.**

Marketing - promotion

26 The present research shows that marketing is one of the key factors in increasing the participation of under-represented groups. Employer liaison and school liaison are vital aspects. To reach women and mature learners, effort also needs to be put into:

- **recruiting specific groups, e.g. women and unemployed adults;**
- **preparing and using suitable recruitment literature for these groups;**
- **devising course names which are more attractive to potential students, not titles which deter all but the committed - if it does not need a scientific background, don't call it science;**
- **ensuring that course titles say who the course is for;**
- **keeping entry requirements as flexible as possible;**
- **interviewing all who apply to give the unqualified a chance to shine;**
- **using female staff to interview women;**
- **mailing specific categories, e.g. all local students who have taken the TVEI technology option;**
- **arranging exhibitions in libraries, community centres and Jobcentres, with staff available to answer questions;**
- **publicising courses in the local and national press and on local radio;**

- **holding open days, mornings and evenings and having computers around for potential recruits to 'have a go';**
- **arranging short taster courses or introduction courses for those considering returning to study or retraining after a long break;**
- **fostering links with organisations such as women's resource centres, centres for the unemployed and volunteer centres;**
- **providing childcare facilities during the interview period;**
- **being specific about entry requirements; not all polytechnics, for example, require specific 'A' levels or Highers in computing to do a computer science degree.**

EXAMPLES

A technology foundation course for women

Recruitment:

- publicity through educational channels, libraries, community and health centres, Jobcentres, sports and shopping centres;
- advertisements in local papers including free newspapers.

The result was an 'overwhelming response' - 140 enquiries.

Selection:

- groups of applicants were invited to one of several open days;
- tutors gave them a tour of the college and discussed the course;
- each woman had two informal interviews with two course tutors, one to find out the reasons for applying, the other to assess motivation and interest in the range of subjects to be studied;
- no qualifications were needed, but those without 'O' level mathematics were given an untimed test; if they failed they were advised to attend the local remedial adult education service and reapply the following year.

A chief education officer in the Midlands emphasises the value of Restart with mature women:

- they used the Restart course to test the water and see how they could manage with something they thought would be difficult;
- a large number were then able to commit themselves to longer courses.

Design, structure and implementation

In general

27 The recommendations here are about the courses that need to be offered, and the techniques needed for running them. The recommendations are:

- **IM should be introduced in some form across the whole curriculum;**
- **an IT department or centre should be set up to change the traditional association between IT, IM and male-dominated technical subjects;**
- **some form of certification should be provided for all courses;**
- **all students should have equal and sufficient access to equipment; courses should include as much practical work as possible;**
- **a variety of teaching methods should be used, including small group work and one-to-one teaching;**
- **in some cases the use of single-sex teaching may be appropriate; flexibility is particularly important in the early stages of a course;**
- **course materials need to be lively and interesting, making use of relevant examples without being condescending, sexist or racist;**
- **learners can be encouraged to develop their own materials;**

- **mature students may need to address the issues surrounding IT, and its implications for society, in relation to their main studies;**
- **careful timetabling can help to attract particular groups;**
- **a clear distinction should be made between IT and IM;**
- **placements should be carefully chosen and supervised to ensure that they offer useful work experience; students should not be expected to work solely in data-entry jobs;**
- **student-managed learning works well if time and resources are properly allocated;**
- **a variety of assessment methods should be used;**
- **childcare facilities for mature students should be provided;**
- **wider use of access courses to suit different under-represented groups should be made;**
- **adequate resources and equipment should be provided so that women have equal access.**

At the basic level

28 The recommendations are:

- **familiarisation courses, or relevant 'bolt-on' modules for all courses should be provided;**
- **timetabling should take account of the needs of particular groups, such as mature students or women returners;**
- **short introductory courses ('Women into Technology', access courses, etc.) should seek to recruit students interested in returning to study but lacking confidence in their ability or academic background; these should provide a springboard to more advanced study;**
- **a route onwards for all basic level students should be provided.**

EXAMPLES

A 'Women into Technology' course for mature students:

- **uses activities related to what students have done in the past to build up confidence, so that only the computing aspects are new (e.g. don't teach accounts packages and bookkeeping together);**
- **emphasises how computers are used across occupations, rather than computer-centred jobs;**
- **encourages students to look at a variety of career options;**
- **arranges industrial visits to demonstrate the variety of computers and uses.**

A 'Work Skills for Women' course:

- **aims to recharge self-confidence, rekindle old skills and develop new ones;**
- **comprises a wide range of subjects, including basic awareness of IT (BAIT);**
- **offers the opportunity to enter for RSA Stage 1 in computer literacy and information technology, or Stage 1 in word processing.**

A 'Computers in the Office' course:

- **offers flexibility - two evenings and two mornings study in small groups;**
- **aims to be available particularly to the general public, including women returners, unemployed people, as well as those with full-time jobs;**
- **leads to RSA Stage 1 in computer literacy.**

At intermediate and higher levels

29 The recommendations are:

- **recruitment should be from basic and intermediate level courses;**
- **entry requirements should be flexible;**
- **a balance between technical skills and problem solving should be achieved;**
- **remedial classes in mathematics, science, keyboarding or English should be offered;**
- **project work should be well supervised and well organised;**
- **while being relevant to industry's immediate needs, courses also need to educate students to cope with changes in the future.**

EXAMPLES (intermediate courses)

An HNC electronics course for women only:

- gave individuals machines to learn on, but did not link them up to the mainframe - to overcome students' fear that they would mess up the whole system;
- gave intense hands-on experience at the beginning of the course - plus six hours of programming.

A college gives mature students:

- more open access time where additional tuition is given;
- project work after an intensive hands-on session at the start of the course;
- materials which relate to business or everyday experience.

A foundation course in technology:

- assumes students have no prior knowledge of the subjects;
- treats each subject in an introductory manner for the first term;
- allows mathematics students to go at their own speed using open learning;
- allows students to take a specialist or general option after one term.

EXAMPLE (higher course)

A polytechnic at degree and HND levels:

- requires students to work in teams to deadlines on problems to simulate a normal professional working environment;
- fosters the development of a team of 'topic consultants' who support the whole group as colleagues;
- project teams of students roleplay written and oral presentations to 'management';
- uses a groupwork facilitator to help all students to participate;
- recognises and builds on existing project management skills in students;
- assesses all courses continuously, and coursework assessments are incorporated in the final results;
- includes a female member of staff on full-time courses, particularly in the early years of a degree or diploma course;
- uses roleplay, simulation and CCTV to prepare students for interpersonal aspects of IT in commerce and industry as well as the technical skills;
- aims to produce a highly skilled business and computing professional by the end of the second year, ready to make a real contribution in the third year, which is an industrial placement.

Guidance, support and progression

30 Preparatory, advisory and follow-up work with learners should seek to direct them to suitable employment or further study, and to monitor the success of the courses. In short:

- **learners will need realistic information on job or educational prospects;**
- **they may benefit from a challenge to consider non-traditional options;**
- **follow-up will help assess how well students are prepared for jobs;**
- **support after the course, in looking for jobs or sometimes with work problems, may also be needed;**
- **guidance should focus on the transferability of IT and IM skills, so that students understand and value what they have to offer.**

EXAMPLE
A London college
A women-only course run in association with a women's training centre:
- includes work experience;
- encourages students to aim for supervisory and management jobs;
- keeps male staff to a minimum, but does not exclude them.

3 Values and needs

31 An assessment of values and needs must go beyond the further education sector because these factors provide the context in which colleges take action. Values are expressed through policy and action; they are based on the interpretation of needs and the priorities allocated to them. Here we consider relevant values and needs from the separate perspectives of:

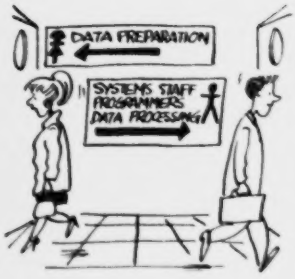
- government and industry
- schools
- individuals
- further education

Government and industry

32 A number of government reports[8] conclude that Britain is facing a shortage of skilled IT personnel.

33 Evidence to the recent House of Commons Employment Committee on Skills Shortages identifies the potential job growth areas with particular emphasis on the need in the 1990s for supervisory and management skills as well as for more hardware, software and 'telecoms' engineers. The education and training of professionals and managers of the future increasingly involves an understanding of and familiarity with the use of new IT and IM techniques across all occupations in industry, commerce and the public sector. Management training must take on board the importance of IM; virtually all managers need to be skilled end users[5].

34 Development of strategies to induce more to enter this field has been given high priority and there is growing concern about particular groups who are under-represented in training courses and IT jobs. It appears that women in particular are failing to take advantage of the new employment possibilities[9].



35 A recent study[10] shows that women constitute:
- 2% of data processing managers
- 7% of systems staff
- 12% of programmers
- 95% of data preparation staff.

36 The figures for women as a percentage of all those taking the following examinations in England and Wales are:
- Computer studies 'O' level - 30%
- Computer studies 'A' level - 18%[11]
- HNC computing and information systems - 21%
- HND computing and information systems - 25%[12].

37 In higher education, despite a proliferation in the number of courses offered, the evidence points to a decline in the number of women taking science and technology degrees, and in IT a failure to fill many of the courses at all. In Information Technology Centres (ITeCs) the proportion of young women is low, and only a small number of young women take the technology option in TVEI. Overall, in the past few years, the number of girls and women in specialist IT education, training and employment has been consistently declining.

38 Women are also under-represented among the increasing number of skilled end users. There is evidence that the introduction of technology has a negative

effect on the jobs women do[13]; there is a fear that this will also happen where IT makes dramatic changes to the way work is done. The danger is that when information management is introduced into jobs which have traditionally been undertaken by women, these jobs are likely either to be taken over by men, or to be characterised as 'unskilled', with women congregating at operative levels and their work largely undervalued by managers and themselves.

39 Many large companies now have equal opportunity policies which commit them to a positive recruitment policy towards women. This is apparent from some recent recruitment campaigns.

40 Some employers may still be biased against certain potential employees. Or they may be reluctant to invest in training people without traditional qualifications. A number of schemes have demonstrated that women and mature learners can be successfully recruited and trained to become competent professionals in IT and IM.

Summary

41 This all appears to indicate that:

- there is a shortage of skilled staff in IT (technologists and technicians) and IM (skilled end users);
- attention needs to be paid to jobs in IM;
- skilled end users are often unaware that they are skilled - so are their employers and some college staff;
- women - whether leaving school or returning to work after a break - are a major untapped resource for employers;
- redeployment from declining industries into IT and IM is desirable;
- a positive approach is needed to address these problems;
- industry is willing to take an active part;
- it is possible to make an impact if positive action is taken.

Schools

42 Many of the respondents in the present research indicated that they see schools and careers services as having a major role in changing attitudes. There is still a tendency for computing to be seen mainly or purely as an adjunct of science or mathematics, or as an elaborate form of recreation. There seems to be ignorance about the widespread use of IM as opposed to IT in all occupations, and the skills needed to prepare people for that.

Schoolteachers

43 Teachers of IT subjects need more awareness of changing applications and opportunities in IM. As well as avoiding classic gender stereotyping, they need to ensure that all students are encouraged to gain confidence in using computers, not just those who may later specialise in computing. TVEI schemes are the obvious vehicle for this, but our evidence does not suggest this has been happening to any significant degree.

44 Non-specialists who teach computing because of their own interest may benefit from further training and updating.

45 Women teachers should be encouraged to work with computers in information management systems so they can provide technologist and end-user role-models.

46 Teachers of all subjects need an awareness of how IT and IM can be used in their disciplines whatever those are. For example, particularly exciting opportunities exist in art, music and pure science. CPVE provides an excellent framework for integration into the wider curriculum[14, 15].

Careers teachers and careers officers

47 Careers professionals working at all levels need to be aware of the variety of career options and the full range of training courses available in IT and IM. There are some dangerous stereotypes to be avoided, some less obvious than others, for example:

- the idea that women are not technical;
- the idea that 'traditional female work' does not involve IT or IM skills (it does; for example, nursing and advanced office management systems);
- the idea that IT is only about technical or engineering skills, and that end use skills are not important.

They need to recognise stereotyping and challenge it if necessary. New careers materials are appearing which will help[16].

Parents

48 Parents also need information about the applications of IT and IM and the career opportunities they offer.

Summary

49 Schools and careers services need:

- knowledge and understanding of the ability of women and girls to tackle IT and IM (there is a long history of women who have demonstrated this)[17];
- understanding of the nature of IT and IM and the skills they demand;
- a commitment to providing those skills;
- techniques and information to encourage the 'non-technically minded'.

Individuals

50 Ignorance about IT and IM, plus a degree of unfounded fear, leading to negative and sexist attitudes is the main problem here. It applies equally to young people at school, their parents and other adults.

Motivators

51 A major motivating factor in looking at IT is that the chances of finding employment are good, and potential financial rewards are seen to be high. This is probably most significant at the higher levels. IT can also provide a good deal of interest and satisfaction, calling for a range of demanding skills and a degree of creativity and innovation.

Deterrents

52 The major obstacles seem to be ignorance and fear. The misconceptions are wide-ranging. Examples are:

- ignorance of how IT and IM are becoming essential for competence and promotion in an enormous variety of jobs;
- mistaken identification of IT as related to science, mathematics and technology only, with neglect of IM and end use;

- if the teaching in school is very academic or theoretical, the feeling that IT is only for the brightest, or those who are particularly good at mathematics and science;
- girls more likely to be under-represented if computing technology or end use is only taught as part of mathematics and science;
- IT seen as a 'male' subject and rejected by women (teaching may reinforce this, particularly if staff are predominantly male; women and less confident students may be excluded from using equipment by more assertive males);
- IT may be set against 'traditionally female' options in the school timetable (e.g. languages), making it a difficult choice for many girls;
- YTS courses emphasise IT and IM in relation to business studies, but, if it is taught as a separate item unrelated to their work, some trainees may view it as irrelevant and resent it;
- adults may lack confidence in their academic background or intellectual ability, and in particular an aptitude for mathematics or science may wrongly be seen as essential;
- practical constraints - for adults these include timing of courses (those in work can only attend in the evenings, those with young children in school hours), the unavailability of childcare facilities and inflexible entry qualifications;
- students with arts or social science backgrounds may think they need mathematics and science, and may not realise that other skills, such as languages, may be equally suitable; they also may not appreciate the potential of IT and IM in their subject, or that they may be essential for postgraduate work.

Further education

53 Colleges were asked for information about courses at three levels: basic (pre-vocational), intermediate (technician) and higher (degree or equivalent). Most respondents were course tutors on the BTEC Diploma in Computing. Many courses were located in engineering or business studies departments and most were taking no special action to recruit women and girls, although all welcomed women to the courses. Many indicated that women are often more successful on the courses than men. Some tutors were frustrated by the failure of their efforts, and a small number were actively trying to recruit women and succeeding.

54 This suggests that few colleges have allocated a high priority to recruiting under-represented learners, and that many have not recognised the importance of IM and the skilled end user.

55 Concern is again being expressed by several bodies (e.g. the Manpower Services Commission and the Polytechnics Central Admissions Scheme) that opportunities offered by polytechnics, including postgraduate conversion courses funded by the MSC, are not successfully recruiting. It seems that the value of taking such courses is not apparent to the people they are aimed at. It is widely agreed that, since 1982 (the year of IT), the impetus has been lost, and probably fewer people understand it, or are interested in it.

56 In a few colleges, great progress has been made in challenging negative attitudes and misconceptions. This is usually due to the dedication of a few individuals. There have also been exciting initiatives to encourage the development of IT and IM provision. However, in many colleges IT is still the domain of only one department; staff from others are denied access, let alone training for themselves and their students.

Satellite photographs are computer-enhanced for map-making.

57 In technical departments there is a tendency to dismiss word processing as 'glorified typing involving mindless following of commands'. Skilled use of word processors involves a good deal more than this, and it may be an example of sexism if there is a failure to recognise and teach both female secretarial students and others the IM skills they need to become skilled end users. Most modern office packages are no longer primitive, single applications, like early word processors, but combine many functions and demand a high degree of information management skill. Formerly distinct items of equipment, such as viewdata terminals, telex machines, electronic mail, fax, photocopiers and database terminals, are merging into single or networked microcomputer applications, capable of great sophistication and demanding skilled use. Secretaries can find themselves acting as underpaid management information consultants, training their bosses to understand the bewildering world in which they find themselves.

58 The clear need for FE, therefore, is to:

- recruit *imaginatively* from *all* available groups in society;
- develop the right marketing methods to make this possible;
- have close contacts with industry to keep abreast of its needs;
- play a part in disseminating that knowledge to schools and parents and overcoming negative attitudes and ignorance;
- develop and improve techniques for building confidence;
- provide a common foundation to all students and, beyond that, modules of IT and IM for all subjects and occupations;
- ensure that all FE staff understand and use IT and IM.

59 FE has already been the setting for a number of important initiatives. Its accessibility and flexibility plus the wide range of its courses offer great potential for building on advances which have already been made. It must accept the challenge to make IT and IM provision across the curriculum.

4 Course design and implementation

60 Course design is about translating values and needs into manageable provision. It must consider not only each individual course, but also the connections between courses, access to them, appropriate levels and progression.

61 Implementation is about the range of techniques and approaches that have proved useful in working with women.

62 This section looks specifically at:

- the present context
- curriculum organisation
- qualifications
- location and culture
- flexibility
- mode of delivery - women only?
- teaching and learning strategies
- standards and assessment
- materials

The present context

63 The basis of much further education course design in IT and IM is still the examination syllabus, or compulsory requirements in programmes such as YTS and CPVE, where familiarisation is mandatory. As discussed in the *Introduction*, one significant problem appears to be confusion between information technology as a branch (or branches) of technology, and information *management* which increasingly involves the use of IT in a wide range of settings, and is creating a demand for people who have what are often called *end user* skills.

64 This problem is compounded where IT provision is located mainly in engineering departments, or specialist IT departments staffed largely by IT technologists rather than IM professionals. It can lead to a tendency to undervalue the skills of end users in IM, because of the belief that technology has removed the need for end users to have any skills!

Product led or market led?

65 Motivation to recruit women and under-represented groups is sometimes derived from falling enrolments on exam courses in IT, which has also led to a proliferation of access courses for women, many funded by the European Social Fund (ESF). This motivation is sometimes accompanied by the expression of fears about the need to admit people with fewer qualifications, and a consequent fall in the standard of provision or rise in the rate of failure.

66 The danger in starting from there is that it can result in a 'product-led' approach, where efforts are directed solely at getting new people into old courses, with no effort to review the curriculum design or adapt to the different needs of this new clientele. (A number of points for designing, structuring and implementing courses for such clientele are given in paragraph 27.)

67 But where the starting-point is a desire to meet the needs of a wider constituency - local industry, individuals, the community - the results are different. In some colleges 'Women into Technology' and similar courses aimed

at basic familiarisation and computer literacy have been very successful in overcoming lack of interest among women and encouraging them to move into further or higher education. This has also been the experience of women's training centres. Recent research[18] indicates that students who enter mainstream courses by this non-standard route achieve good results.

The learner's perspective

68 The majority of students in the survey indicated that their primary motivation was to achieve skills which would bring them jobs or promotion; many believed that successful IT and IM courses would make them more marketable, and so they favoured courses which they believed reflected local and national market needs. For them, the ideal arrangement would be courses designed in negotiation with local companies, with students sponsored on day-release and sandwich courses.

69 PICKUP courses are one successful model of this type of flexible provision, and could be used more extensively[19].

70 In areas of high unemployment, courses and qualifications cannot be regarded as a passport to jobs, especially for mature learners. Computer familiarisation courses can be part of a general life-skills and confidence building programme; some tutors felt that developing IM and IT skills can be very good for self-confidence.

Curriculum organisation

71 Curriculum organisation is about the quantity, range and structure of courses offered. Over the years, several FEU reports have addressed the issues of widening access and opportunities for women[20]. However, many of the recommendations made have yet to be carried out on the scale necessary, despite the efforts of a committed minority.

72 There is no one correct approach. The comments here reflect the views of practitioners who are seen to be working successfully to widen the scope, relevance and success of their provision.

How many courses?

73 Reference has already been made to the lack of recruitment to higher level courses in IT, though there are some honourable exceptions. Clearly the correct response is not to reduce the numbers of these courses, given the skill shortages there are. What is needed is:

- a wider range of basic access and intermediate level courses;
- better recruitment of women and under-represented groups, which means widening the net beyond the present minority;
- access at different times of year, for different purposes and at different levels - one major reason for people not enrolling is that they cannot always fit in with fixed college practices;
- better guidance on progression either into work or on to higher levels.

74 A greater number of courses lead towards a more modular approach; in turn this is leading to the use of more flexible or open methods (e.g. where people work through prepared distance learning material and book into college for telephone or face-to-face support, access to equipment, etc.).

75 Tutor roles are changing to meet the needs of people with children, at work, or with acute problems of confidence. This entails less direct teaching in large groups and more work with small groups; they could also work more with individuals, using counselling, guidance and support. Learners may of necessity need to do more on their own, perhaps in pairs, or using mentors.

76 Short, specific courses will become increasingly familiar and necessary as credit accumulation towards recognised qualifications over a period of time gains popularity and acceptance. Such courses are in response to the approach to validation encouraged by bodies such as the National Council for Vocational Qualifications (NCVQ).

77 The arrival of the NCVQ is leading to the development of competence-based qualifications, which also facilitate the development of modular programmes which can be linked together.

Levels

78 Introducing greater variety presents a challenge to course designers, who must seek to improve quality and standards, not reduce them. The research revealed a range of approaches; the main thrust seems to be:

- introductory access courses to understand what IT and IM are and do, and overcome any confidence problems;
- modules of IM to 'bolt on' to other courses (supported in some cases by the BTEC Information Technology module, which can be incorporated into other BTEC courses);
- specific courses to meet local employment needs (usually supported by the MSC, or through PICKUP); these cover a range of IT and IM subjects, including basic practical business computing and software engineering;
- degree or HND level courses with women in mind, sometimes emphasising non-computing skills (business communication, finance, negotiation, etc.).

79 Access courses[21], designed to attract women and other under-represented groups to both IT and IM, should be used to find and motivate students who will transfer to longer or more technical courses, and not simply to boost students' confidence and morale. It would be a significant step forward if examining bodies were willing to use non-threatening titles for IT-related qualifications. For example, a CAD/CAM (computer-aided design and manufacture) course for women, set up specifically to meet local employers' expressed needs, failed to recruit, probably because of a lack of understanding of what CAD/CAM is, as well as the fact that it is a forbidding name to non-technologists.

80 Such courses will provide a pool of suitable and eager recruits for those intermediate and higher level courses which are presently failing to attract enough students.

81 There is currently a national shortage of professionals in computing and other disciplines (e.g. engineering) and yet, at the same time, there are many people qualified for higher education but in the 'wrong' subjects. To reach this group and thereby use this largely untapped resource, the HITECC (Higher Introductory Technology and Engineering Conversion Courses) initiative*

* The HITECC (Higher Introductory Technology and Engineering Conversion Courses) and the HITECC Unit are one of the special initiatives offered to the NAB by the secretary of state for education and science. Further information from the HITECC Unit, National Advisory Body for Public Sector Higher Education, Metropolis House, 22 Percy Street, London W1P 9FF, telephone 01-637 1132

through participating polytechnics and colleges, is designing courses to encourage more women in this category into computing and engineering. Study is flexible and allows credit for previous qualifications and experience. Short free 'taster' courses for women only, sponsored by the Engineering Industry Training Board, are being offered.

Information technology or information management?

82 The lack of definition between IT and IM may be partly due to the lack of a coherent framework of courses. There is a bewildering diversity of approaches. The ideal would be co-ordinated provision with a wide range of interlocking programmes, from basic to degree level. Overlap between IT and IM would be addressed by using shorter, more specific modules, where the distinctions would have to be clearer, for example database applications (IM) or basic robotics (IT).

Qualifications

83 As well as the range of existing degree courses, a number of new qualifications are appearing with IT and IM in mind. BTEC has a Business Information Technology course which can be defined very largely by individual colleges; City and Guilds and RSA are both offering a number of awards at various levels, from basic to advanced. Non-threatening assessment is also used successfully; for example, one polytechnic feeds its degree course with a non-examinable foundation course that runs in the evenings, with no adverse effects on standards.

84 In some cases the course and qualification will be IT-specific. In others, where IM is part of a wider field, the qualification will be in a different discipline, where it may be important to be able to demonstrate a knowledge of IT and to offer some kind of evidence of competence. There is an increasing variety of qualifications which can be offered by courses in IT, covering both these possibilities.

At the basic level

85 Some courses, often for mature learners, provide no formal qualifications at all, e.g. some 'Women into Technology' and introductory YTS computing courses. These play a key role in increasing the confidence of learners, both in using new technology and in a more general sense. However, they may command little recognition from employers, which may be a source of disappointment to those involved. Some of the new unit-based awards should fill this gap.

At the intermediate level

86 Recent trends in qualifications are giving increasing flexibility to colleges. The new BTEC Business Information Technology Diploma allows flexibility at entry and encourages employer participation, with a high proportion of the syllabus determined locally. RSA and City and Guilds have both introduced new modular programmes which are competence based, and so attempt to validate practical and proven skills in use rather than in theory. BTEC also offers modules that can be 'bolted on' to other courses across the curriculum.

At the higher level

87 The clear impression is that once under-represented groups (especially women) arrive, they do well. Entry requirements need to be adjusted to allow motivated, capable people without the usual background to gain access.

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88 Rigid or inflexible entry requirements are both unnecessary and a significant deterrent for women and under-represented groups; some colleges have found that students without mathematics or science 'A' level can still succeed on IT courses. Links with access courses or women's training centres do provide good recruits, and contribute towards a more coherent framework of provision. Some form of bridging process is better than simple rejection of, for example, people with an arts background who want to study IT. In IM, because of the wide range of skills involved, the imposition of rigid entry requirements seems even less justifiable.

89 The HITECC campaign (see paragraph 81) is intended to bridge the gap between people already qualified for higher education but in the 'wrong' subjects, and the national shortfall in computing and engineering professionals.

90 A further issue, which NCVQ will seek to address in the longer term, is that the proliferation of new qualifications has left employers wary and confused, lacking any frame of reference. Colleges need to help their students explain what their qualifications mean when they go for interviews, as part of a wider campaign to have them recognised and valued.

Location and culture

91 Because of the confusion between IT and IM, there are many different approaches to locating the provision. One approach is to have a separate IT department which provides its own courses, but also services all the other departments.

92 Specialist IT courses are taught in business studies, engineering, mathematics or science departments. This may well be a factor in recruitment; the vast majority of students in engineering departments are still male, although recently there has been improvement where there has been specific intervention, such as WISE (Women into Science and Engineering). The BTEC Diploma in Computing Studies, normally taught in engineering or science departments, is heavily male dominated, whereas the Diploma in Business Studies attracts a more evenly mixed group, even though it contains many similar elements. Since an IT department is one possible resolution, it is worth considering both the advantages and the risks.

Advantages

93 The advantages are:

- reduction of the dominance of other departments which may tend to overspecialise in their own subjects;
- opportunity for more comprehensive and flexible provision;
- wider access to the best physical resources.

Risks

94 The risks are:

- traditional users (e.g. engineering departments) may feel they have lost access to valuable resources;
- staff may not have good all-round understanding of applications;
- it may isolate the use of IT even more.

Appendix A The research process

In-depth interviews

1 A series of interviews was conducted with: heads of FE colleges in England and Wales; a chief education officer; a senior adviser in microcomputing; a careers officer; the country's first professor of IT; and consultants in IT training, particularly for women. Also interviewed were practitioners working in FE colleges, polytechnics, universities, government training schemes, ITeCs and women's resource centres.

Workshops

2 Half-day workshops were held in Cambridge, Cardiff, London and Manchester. They attracted a diverse group of participants from education and public life, who were united by a common interest in science and technology education for girls and women. The workshops were conducted as informal discussions between participants, focusing on the issues and problems involved in teaching IT, particularly as these relate to women, and the strategies that have been adopted to address the issues and overcome the problems. It was agreed to circulate the names of those who attended to all participants, in the hope that this would form the nucleus of a network of people concerned with the education and training of women in IT.

Questionnaires

Practitioners

3 The practitioners' questionnaire covered similar ground to the workshops, although necessarily in less depth. It was sent to 200 colleges, at every level of FE and HE provision. The impressive response suggests that there is already a consciousness among a significant number of practitioners about the difficult challenge FE faces in attracting new learners to IT and addressing the under-representation of certain groups.

Learners

4 The learners' questionnaire provided an interesting contrast. It was distributed to male and female learners, including mature students. It sought to discover the factors which had motivated learners to pursue IT, factors which might have been a disincentive, and teaching strategies they found helpful, especially in overcoming any particular problems. The response shows that a great deal can be learnt from the experience of students which may be helpful in forming effective teaching strategies in IT.

Literature review

5 A survey was made of the recent literature concerned with employment and IT, particularly the employment of women, and education and training in IT, again particularly relating to women.

6 It also provided a general context of work which has already been done to attract women and other groups to science and IT education, as well as describing a number of important initiatives, many government sponsored, which have achieved positive results in this area. There has been much discussion of course content and teaching methods and how to attract under-represented groups into IT training, and some of the ideas and conclusions presented in the literature form the basis of this report.

Flexibility

95 Flexibility is the keynote for course design; in practice this means courses:

- at all levels, especially introductory and access;
- held at various times and in different places;
- covering both IT and IM;
- linking to one another through a system of accruing credits;
- fitting in to other subjects or occupations where appropriate;
- using modular approaches where appropriate, i.e. short and specific.

Mode of delivery - women only?

96 Women form a major under-represented group in specialist IT courses and jobs. In recent years there has been considerable discussion about whether single-sex teaching of mathematics and science subjects in schools encourages girls to opt for these subjects. This debate has extended to IT, where it is most relevant at the basic level. It may be difficult for girls or women to learn if they are in a minority and also lacking in confidence.

97 Women's training centres and some women-only computing courses assume that the most effective environment for teaching women is one with no males who may monopolise equipment or undermine confidence. Women students appreciate the support they get from one another. A typical comment from a mature student is 'it helps to learn with other students in the same boat as me'. On the other hand, some tutors fear that single-sex classes may be counter-productive. One lecturer argued: 'Learning should be based on reality. Separation by sex would be inappropriate. Women might learn more, but are they able to apply that knowledge any more effectively in the world beyond education?'

98 There are good arguments for single-sex courses; but beyond the basic level (e.g. 'Women into Technology' courses and similar) they are not a realistic option because the need is to recruit as widely as possible. In this case working with women only is appropriate in the early stages of a course as a means of building confidence and giving basic knowledge. They can then progress successfully to a mixed group.

99 Because of this, some practitioners who are committed to working with women use the concept of *critical mass*. They try to ensure that there are at least five women on every course. This number is thought to be enough for them to get support from one another and counter feelings of isolation or being in a minority. The results are encouraging, and, although sometimes recruiting even five women can be difficult, the concept of critical mass is helpful.

Teaching and learning strategies

Learner autonomy

100 Some practitioners and students believe that student-managed learning needs to be encouraged in IT and IM.

101 Hands-on experience of equipment is seen as one of the most important elements. Also, some of the most satisfying and successful work is done through individual and small group computer projects. These encourage students to work co-operatively and foster the development of self-help and mutual support systems.

7 The present research constitutes the core of this report. The data was obtained from both practitioners and learners, through interviews, questionnaires and workshops, and these add a personal dimension to these issues.

8 This information has contributed to the analysis of the problems surrounding IT education and training and to the positive suggestions made in the report.

102 The ability to benefit from student-managed learning may itself be a skill that has to be learned[22]. Equally, tutors need to develop skills in fostering learner autonomy and managing the learning environment. Student-managed learning can be linked to resource-based learning; there is already a number of open learning packages, and these will continue to appear as providers of open learning, e.g. The Open College, develop and grow.

At the basic level

103 In both IT and IM, some students (male and female) are likely to lack confidence and to need encouragement, one-to-one or in small groups. Activities designed to give early success are widely recommended, particularly structured hands-on experience which quickly overcomes much of the mystique. It seems to be equally important to make the course as relevant and real as possible.

104 Some students may be hostile and bored (especially if they have no choice about attending), and relating the computer to their work or personal interests may be difficult. The aspect of computing which girls most frequently recognise the value of seems to be word processing. Starting from that, and demonstrating the basic IM skills that modern word processing programs demand, may be the best way to widen their perspectives towards the use of other, perhaps more powerful, packages.

At the intermediate level

105 In both IT and IM, project work in small groups can give the satisfaction of seeing something through from start to finish, whether it is designing a new type of aid for the disabled (IT), identifying and curing a hardware fault (IT), creating a budget on a spreadsheet for a charity (IM) or designing a data-entry screen to make it easy for warehouse attendants to update stock figures. This

Fault-finding in hardware assembly.

type of approach also seems to improve self-confidence and communication skills. It needs to be carefully designed to make sure that less assertive students play a full part and that no one 'freezes' into traditional female roles, such as taking the notes.

At the higher level

106 Many practitioners at this level do not see a need for special techniques. For example, in traditionally male-dominated, higher level courses, male tutors see no need for special teaching strategies aimed at women. This may be because the women on these courses are generally well motivated and resilient,

Appendix B Synopsis of the literature review

1 Current literature on computing, information technology and education, with particular reference to females, covers four main areas:

- employment
- education and training in further education
- science and technology education and girls
- females and computing and information technology education and training

Employment

2 The literature suggests that women are losing out as a result of the changes to Britain's labour market under the impact of computing and information technology. Women face the largest number of job losses consequent upon the introduction of new technology; and some typically female occupations, such as office work, are being degraded and deskilled. Women are also under-represented in the more prestigious occupations which have developed as a response to computing and information technology. There are very few female technicians and systems analysts, and a declining number of programmers. Females are concentrated in the lowest paid and most unskilled computing and information technology jobs, such as data processing.

3 This was not always the case. When computing and information technology were first introduced, women benefited from the lack of barriers to their employment, which existed in older, male-dominated occupations such as engineering and printing. Also, traditionally having far fewer formal qualifications than men, women were able to enter an industry where few formal qualifications for employment had been introduced. Over the years, a variety of economic and social factors have negated these initial advantages. In particular, as formal qualifications are increasingly seen as a vital entry requirement into information technology careers, women are now suffering from the consequences of their overall lack of training and education in this field. But it is also widely noted that the rapidly changing nature of new technology means that training, for both males and females, is not a once-and-for-all matter. In all likelihood, training will become a recurring feature in the careers of a growing number of IT employees. Job flexibility and a willingness to retrain are important attributes of the present and future labour market in computing and information technology.

Education and training in further education

4 The literature on education and training in computing and information technology covers two central topics. First, what constitutes an adequate preparation for a career in computing and information technology, particularly, what is 'computer literacy'? Second, how should computing and information technology be taught?

5 In the first case, there is controversy as to whether programming is essential to producing a computer-literate population. Some studies quoted in this report suggest that future IT jobs will require educated end users, able to apply programs in their particular work context. Some even believe keyboarding is the only skill most computer users will eventually need. Others insist that an ability to program can give crucial confidence to a range of mixed-ability students at the further education level.

Using video for roleplaying interview practice.

and so succeed. (There are, however, few of these women and, worryingly, the number is getting smaller.) Some practitioners vehemently disagree with this, and would regard it as an example of complacency. They use a wide range of methods, including consciousness raising, simulation and roleplay and the use of video to change self-perception.

Work experience

107 The use of work experience placements is seen as essential by many practitioners, particularly on courses aimed at preparing students for the local job market. Not only can they increase confidence and motivation, they also allow employers to see the extent of the students' abilities. This is particularly important for women and other under-represented groups who are often without a recent work record or any qualifications. In some cases work experience placements may lead to job offers. Work experience should be of sufficient length and scope to enable the student to put the skills learned into practice by undertaking a real project and, at the same time, learn about commercial and industrial priorities. The tutor will also gain valuable knowledge of the skills required by local employers.

108 Placement co-ordinators will need a high degree of counselling and diplomacy skills. For example:

- some employers may automatically offer women 'traditional' tasks such as data entry, and may be unwilling to give meaningful placements to people with no apparently relevant experience;
- some women may slip into familiar roles, e.g. secretarial or personal assistant, where they are very confident and skilful.

'Hard' and 'soft' skills

109 An issue which stimulates some controversy is the extent to which the more technical and theoretical 'hard' skills, for example of programming, should be taught on all courses. Some people argue that knowledge of programming can give a feeling of confidence and mastery even to users of IM (where applications programming is more appropriate than the software engineering skill of program building). Some colleges include programming as a compulsory element but leave it as non-examinable, so that basic competency is achieved without the rigid requirements of a specific syllabus. One polytechnic which successfully recruits women to a degree level computing course finds it difficult to interest

them in 'hard skills' options such as artificial intelligence (even though the tutor is female). Since there is no consensus about this issue, it could well be that the attitudes of teaching staff are an important factor.

A remedial safety net

110 The sample showed that on intermediate bridging and conversion courses there are students with great motivation but definite weaknesses in, for example, mathematics. Mature students, women and arts graduates often feel inadequate in these areas; some courses may demand a proficiency in mathematics which is beyond them. A serious commitment to providing a service to this group will include a facility for remedial help, sometimes to quite a high level.

Standards and assessment

111 Although final assessment is often fixed, it is increasingly possible to be flexible about the forms of assessment used.

112 Many practitioners feel that less confident students do less well with exams than with other, more flexible forms of assessment. This appears to be especially true at the basic level. One school reported a considerable drop-out rate among girls on the TVEI technology option as soon as the exam was introduced. In contrast, young women who have the confidence to tackle such courses as BTEC HNC electronics produce exam results which are as good or better than those of their male counterparts.

113 There are a number of assessment methods which are used at all levels; often the course uses a mixture of:

- formal examinations
- multiple-choice tests
- continuous assessment
- performance

Formal examinations

114 Some courses have dispensed with formal exams altogether, although, for many people, passing an exam gives an immense sense of achievement. The exam is still the major means of achieving intermediate or higher-level qualifications in IT.

115 In IM there are few examinations above basic level, although these are becoming more available. Business studies degrees and management diplomas are now offering information management, and are including topics such as network management. This will become more common as NCVQ encourages a trend towards qualifications which increasingly develop competence-based assessment procedures for all vocational qualifications below degree level.

Multiple-choice tests

116 At the basic level multiple-choice tests, combined with practical tests of competence, are the main form of assessment in both IM and IT. IM especially is the subject of several new sets of tests developed by City and Guilds and RSA.

Formative assessment

117 Formative assessment of coursework is popular because it allows learners to see their skills growing and developing; the collection of a portfolio of achievements is widespread at the basic levels such as YTS, and in

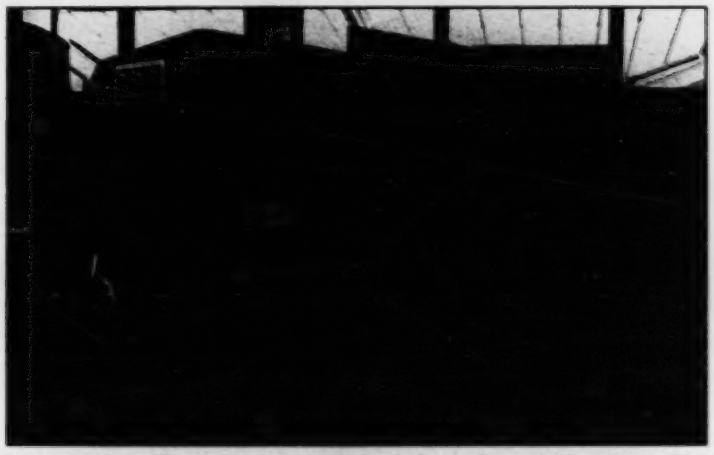
familiarisation programmes such as 'Women into Technology'. It is seen to work well with mature learners, who may undervalue their achievements unless they are validated by a tutor or someone with authority.

Competence

118 Related to this is the growth of competence-based assessment, now mandatory in all MSC programmes. Competence means the ability to use skills to perform real tasks; the increasing popularity of the term indicates a shift from the measurement of skills in isolation towards assessing them in action, preferably at work. More and more courses are now expressed in competence terms, and efforts are being made to extend the use of work-based assessment to allow this to become more reliable. The practical nature of much IM and IT lends itself readily to the approach. Furthermore, NCVQ has endorsed it. Although only in the early stages, this approach is likely to make radical changes in our systems of assessment for vocational qualifications.

Materials

119 There is an enormous variety of materials available, but also many doubts about the quality of much of it. Some tutors felt they had to spend too much time in developing their own course material, and many practitioners felt they were reinventing the wheel. The facility to pool resources would spread good practice. ResCue, an electronic network for vocational education and training*



Job vacancies and training opportunities can be made available to the public by installing terminals in, for example, libraries.

is intended to provide a resource for teachers needing information and assistance on pre-vocational education, curriculum and staff development, and information on materials and assignments. It is supported in every area by FEU Regional Curriculum Bases.

120 It is generally accepted that material works best when it is seen as relevant. Some tutors have developed materials which place IT and IM in familiar contexts, or liken them to skills students already have and experiences they bring to the course. This is especially true in IM when a computer package is often a means to an end in another subject. For example, a key skill in using accounts software is bookkeeping; in financial modelling use of spreadsheets and basic

* For more information, write to the public relations officer, TTNS, PO Box 7, 200 Grays Inn Road, London WC1X 8EZ

financial concepts need to be understood. Using the learners' own experiences removes the need to teach two things at once: the computing skills *and* the subject.

121 But there is a danger of seeming to reinforce stereotypes. The classic example is the idea of using recipes or knitting patterns to teach women the elements of programming. Many respondents were strongly against this approach; one commented, 'You wouldn't teach a woman to drive using knitting patterns'. More neutral exercises based on topics such as planning time or personal budgeting were preferred.

122 People working with women did stress the importance of avoiding materials which could appeal to the interests of one sex only - for example, exercises based on football scores may reinforce the sense of computing as a male preserve.

123 Where IM is being taught as part of vocational courses such as nursing, banking, retailing or business studies, all the material should be drawn from the field of study. Detailed case studies showing how it was introduced and what happened, who did what and how, were regarded as one of the most powerful types of material, especially where based on reality.

124 There is a clear need for material which has at its centre a clear concept of the differences between IT and IM. Such material should:

- value end-user skills;
- define such skills to standards;
- avoid sexist or racist language and illustrations (particularly bad in IT at present);
- clarify the role of IM in the whole range of occupations.

Conclusion

125 There were very few problems expressed about materials. This could be a sign of complacency, given the very small numbers of people from under-represented groups, especially women, who actually appear on the courses. Where efforts to recruit are successful, more innovative teaching methods and specific techniques are used (see *Recommendations*).

126 Most practitioners feel that they are succeeding with unmotivated and under-represented groups when they get them. Again, the keynote is flexibility and sensitivity, which means a willingness to:

- make use of ResCue and other databases;
- use a wide range of methods and materials;
- provide women-only courses if possible;
- use the concept of critical mass;
- avoid overloading by trying to teach subject skills and computing simultaneously (e.g. bookkeeping at the same time as how to use a computerised bookkeeping package);
- offer a choice of assessment methods;
- provide a range of qualifications.

5 Evaluation and review

127 The processes of evaluation and review seek to discover the extent to which provision has succeeded in meeting needs. They therefore provide the basis of future curriculum development.

128 It is important to establish the criteria by which to judge the success of courses in IT and IM. Traditionally, FE values examination success above all else, and this must continue to be a crucial indicator. But other measures are needed, especially to establish the success of courses in addressing the needs of under-represented groups.

129 This section looks at evaluation and review under the headings:

- recruitment and drop-out
- support and guidance
- progression

Recruitment and drop-out

130 One measure of success is the number of students a course attracts. Some IT courses have difficulty attracting enough students. Where enough students are attracted they often make traditional choices - for example, a preponderance of women in secretarial courses where IM is often undervalued, and a majority of men in IT courses leading to higher status jobs such as systems analysts. The indications are that where women are successfully recruited at professional levels they tend to excel.

131 Numerical indicators of success should be measured not simply with totals, but also with numbers of under-represented groups - more boys in business studies (doing secretarial work), more girls in engineering, more mature learners everywhere.

132 Sometimes the lure of employment is stronger than the potential but uncertain benefits of further study - one ITeC tutor reported that all her girl learners had left for jobs as soon as they had acquired sufficient word processing skills, without progressing to the electronics part of the course. The girls may have made a realistic choice - but were they settling for less than their abilities allowed? Or would a greater emphasis on IM applications other than word processing have kept them, since practical business computing skills (word processing, database creation and use, spreadsheets and communications) are highly valued, and in short supply?

133 The drop-out rate among girls who take degree level specialist courses in IT subjects is lower than that of their male counterparts, perhaps because they have had to be more highly motivated. A useful determinant of success therefore is not the low drop-out rate now, but maintaining it if numbers of women students increase (though at the time of writing in late 1987 they are falling).

134 The drop-out rate is consistently highest among unemployed mature students, though this does not apply to courses aimed at women returners. The experience of significant unemployment seems to be an important factor and may affect more men than women, although an effective measure of success would be the number of mature students who complete the course, and get a qualification. It may be necessary to distinguish between males and females - could it be that women are harder to recruit and easier to teach than men? If so, the criteria for success at the recruitment stage would be different from those at the course evaluation stage.

Range and structure

135 Drop-out should not simply be blamed on the students. They may be victims of an insufficiency of basic, bridging or access courses. They may also have succumbed to the pressures caused by inflexible timetabling and all the issues identified in *Course design and implementation*.

Support and guidance

136 The drop-out rate among mature students is high (especially among men - women seem to have more staying power). This should stimulate colleges to provide better student support. This may mean:

- remedial help;
- extra tutorial support;
- the encouragement of self-help and mentorship;
- the development of mutual support systems in groups.

137 Support and guidance also need to address the expectations some students are reported to have when they arrive. The problem could be that they are recruited to a course which is more advanced and specific than they can cope with. They may well have needed an introductory access course, where they could find out what kinds of courses might be suitable for them and assess the skills that might be involved, at the same time as gaining confidence through the acquisition of basic IT skills.

Progression

Employment

138 For most people the greatest motivation in gaining IT skills is their usefulness in gaining employment. How many people get jobs at the end of a course is an obvious measure of its success. However, at the basic level, some tutors reported that although learners may get jobs, they are rarely so 'exalted' (as one put it) that they could be called IT jobs. Many women are content to opt for word processing, even if their qualifications mean they could aim higher - often word processing is not viewed as an IT or even and IM skill, and many employers do not give it the status it deserves.

139 This attitude needs to be challenged and the skills involved in word processing fully recognised, by employers, students and tutors. The refusal to recognise secretarial and clerical jobs as skilled is one of the more deeply embedded examples of sexism in our work culture; curiously it appears to be a relatively recent phenomenon: in the 1930s and even the 1950s, men who typed were accorded status as a result, and were not unhappy about being called secretaries.

140 Success can also be measured by the value people place on the skills they learn, and the extent to which negative attitudes are changed.

Education or training

141 Progression to higher level courses does not seem to be a major objective in all basic and intermediate courses. Greater awareness of what is on offer should have an impact on the numbers recruited to some very exciting degree level courses currently ignored. Lower level courses can encourage learners to move upwards to higher education, and the resulting qualifications may be more helpful in finding employment. YTS trainees who progress to BTEC courses, mature women who move on from 'Women into Technology' to access courses, and HND students who go on to take degrees will all be maximising their future

career prospects. The arrival of educational facilities such as Training Access Points, Education Counselling and Credit Transfer Information Service, and DOORS may affect this.

Personal development

142 In some parts of the country, finding employment in IT or IM is very difficult, particularly for those with few qualifications. In such cases the number of students finding work is not felt to be a reasonable criterion by which to judge the success of the course. Assessing the degree to which the course has improved self-confidence and personal skills is preferred.

Employers' needs

143 The extent to which employers' needs are met is another important criterion for success. This depends on industry indicating to colleges which skills they require of their recruits and thus which could usefully be taught in the curriculum; and for colleges to advise industry on new developments in technology and new ideas in work practices. Training courses designed in conjunction with employers and courses for day-release or sponsored sandwich students will be likely to meet employers' needs most closely. The number of students who get local IT and IM jobs is a clear indicator; the willingness of employers to provide work experience and the satisfaction they express about it is another.

Conclusion

144 Some useful criteria for measuring success are:

- Has the course succeeded in attracting students?
- If compulsory, has it succeeded in rousing interest and encouraging participation?
- Have traditional choices been challenged or reviewed - such as women opting for secretarial studies, or thinking that word processing is little more than typing?
- Are students encouraged to progress to specialist IT courses or to develop their IT or IM skills further for use in other occupations?
- Has the course improved students' confidence, both in using IT or IM and more generally?
- Has the course improved students' employment prospects?
- Have students been encouraged to proceed to higher level courses?
- Has it equipped them for specialist IT jobs?
- Has it equipped them for IM in other jobs?
- Has it equipped them to be ready for future changes in their working lives, whatever industry they are in?
- How fast have they learned what?

6 Support

145 This section collects together the recommendations of other sections and considers the support issues they raise. The preceding sections have highlighted the following issues:

- the need for energetic, flexible and innovative recruitment policies and practices;
- the need for marketing specifically aimed at women and other under-represented groups;
- the need to attack ignorance and fear among parents and others;
- the need to develop techniques for building confidence in potential learners;
- the need for a common foundation programme, with links to many possible options;
- the need for college organisation to reflect the wide range of IT and IM applications;
- the need to develop courses at various levels, within other courses, at flexible times and in flexible formats;
- the need to develop women-only courses, and use the concept of critical mass;
- the need to appreciate the importance of end-user skills, and distinguish these clearly from technological skills;
- the need to provide relevant and attainable qualifications;
- the need to stay in touch with labour market needs;
- the need to provide guidance for learners on entry, during the programme, and at exit;
- the need to provide support and help for staff.

All these have implications for support.

146 There is a growing number of committed individual practitioners who are working hard to address the problem of IT, IM and the under-represented learner. The largest number seem to be working on the issue of women, but there are few colleges with a coherent policy on this, or which have invested significant resources into achieving better results. This section looks at:

- a college policy
- staff
- materials
- learners
- equal opportunities
- marketing

A college policy

147 Many respondents felt that support needed to be made available to all those involved in IT and IM on a college-wide basis. It should form part of a wider commitment to supporting the development of IT and IM to meet the needs of the nation and the community, which takes the form of a defined college policy. A description of what such a policy could cover is offered in *Recommendations*.

Staff

148 Tutors of IT and IM need continuous training to keep up to date with all the developments in the field. They may also need training in participative approaches and learner-centred techniques which go with some of the newer qualifications. Many respondents said that they had to undertake training or updating in their own time and received little or no official support.

149 Tutors of other subjects need the opportunity of training, either to make sure they understand how IM has entered their field (and so can communicate it to their students) or just to see how they could use the opportunities IM presents for them. Few instances of this kind of support were revealed in the research.

Cross-departmental support

150 IT is a specialist subject in its own right and should be recognised as such; IM should be viewed as part of the remits of all departments and relevant in a very wide range of subjects. Departments with specialist IT knowledge will need to support those in which IM is being introduced, and all departments can help one another in discovering how IM can best be taught and used.

151 One college which has a specialist IT department aims to provide this type of staff support; in addition, it should form part of a college staff development policy. The arrival of new qualifications in IT for staff may promote this by bestowing recognition on the acquisition of these skills.

Support staff

152 Technicians and librarians are potentially powerful allies in the support of an IT policy for the college. Commitment from library staff, especially, can lead to:

- keeping up-to-date material;
- developing and sharing it with other staff;
- collating and disseminating information from each department about recruitment and teaching issues.

153 Databases such as MARIS and the PICKUP short course directory are powerful aids which may be wasted without the availability of support staff to access them.

Materials

154 There is now a growing body of material aimed at supporting tutors who wish to work with women. Membership of the various groups that are producing it, and a commitment to keep the college resource library up to date with this type of material, is the outcome committed practitioners would like to see.

155 Materials which embody sexist or racist images or assumptions (the over-use of 'he', or illustrations only of white males doing technological, technical or management tasks) should be discarded and new ones developed or purchased.

Learners

156 Among under-represented groups, more support may be needed than is usual. Examples include:

- the need for diffident mature students to feel they can practise without being watched over or laughed at;
- the need for childminding;

- telephone access where there is difficulty with homework;
- remedial top-ups;
- educational and vocational guidance.

157 Often students can support one another; this is encouraged in some colleges through the use of mentorship, where students have a person to whom they can turn for support who is not necessarily a teacher (and never the course tutor). This informal learning support or mentorship is gaining recognition in industry and open learning. Also, the concept of critical mass is useful in building supportive groups.

Equal opportunities

158 The difficult issue of equal opportunities is being addressed more and more directly by government and industry. Often the first step is to recognise the need for a policy and then to disseminate the existence of the policy energetically. The appointment of someone with responsibility for equal opportunities is one way of making progress. Such a person will need to be sensitive and skilled, especially in working with departments and staff who see no need for an equal opportunities policy. A policy to monitor course applications and recruits will strengthen the marketing effort.

Marketing

159 Marketing is a current focus in many FE colleges; the need to identify markets and cater for their needs - to be market led rather than product led - is recognised everywhere, and efforts are being made, mainly in communicating with industry.

160 The recruitment, support and progression of under-represented groups into IT and IM courses has powerful marketing implications. It is a tricky area and requires careful local research and knowledge. People do not turn up simply because of a bigger or brighter advertisement; they need to feel empowered and supported and to see the potential relevance of what is offered. A diversity of access courses, promoted by local publicity and, increasingly, by national publicity from the media, is seen as the most effective way forward, because of the need for guidance as discussed in *Evaluation and review*.

Conclusion

161 In summary, colleges need a support policy which results in:

- staff training and development;
- cross-departmental support and resource sharing;
- adequate trained support staffing;
- a declared commitment to equal opportunities;
- energetic marketing to recruit under-represented groups.

6 There is another argument that all students should receive a computing and information technology education broad enough and flexible enough to be relevant to the new skills which are bound to arise in the future as new technology develops. This education would involve training in basic computing skills such as keyboarding, but also a background in problem solving, teamwork and other interpersonal skills.

7 The further education sector, which is involved in both education and training and has strong links to industry, is seen as an ideal arena for this computer literacy to be generated.

8 However, it is widely noted that many innovations in computer teaching are to be found not in the formal education sector, but outside - for instance, in government training programmes under the MSC. Many of these programmes emphasise hands-on experience of computers, a non-exam oriented curriculum, modular courses and work experience. These courses try to be particularly responsive to the needs of the local industries. Such teaching methods and course organisation are said to be highly appropriate in a field in which technology is in a constant state of flux, and with students who have frequently failed in more formal educational settings. Others criticise the courses as putting the needs of industry above the personal development of the trainees.

Science and technology education and girls

9 Girls and women are not sharing in the expanding provision for education and training in computing and information technology. There is a vast and contentious literature about why girls and women are alienated from science and technology education. Much of this focuses on the school.

10 Views vary as to whether girls are turned away from science and technology education irrevocably when they are young, or whether this is a process which can be reversed. Studies do agree, however, that, by their early teens, a majority of girls decide against science/technology education and careers. Blame for this is laid at a number of doors. Some believe girls are socialised to expect to be mothers and housewives above all, and so lack interest in science/technology careers which require training. Others feel that girls reject science as impersonal and inhumane, and are more interested in the 'caring professions', to which most science and technology appears to have little relevance. Career teachers and parents should do more, it is said, to encourage girls to opt for non-traditional career choices.

11 The way science and craft, design and technology are taught in school is also felt to alienate girls. Apparently, many science teachers do not expect their female students to do as well as boys. Boy students often share similar views. In addition, boys frequently get more than their fair share of the teacher's attention. They also get far greater time with computers and other equipment than do girls. As a consequence, girls may lack the confidence to pursue science and technology education and training. Girls might also lack interest in a subject which is often taught in a way which completely divorces it from its social and political context and implications. These and other reasons lead most girls to drop science and technology subjects when given the option. This leaves the girls who persevere in these subjects greatly outnumbered, and so even more prey to feeling vulnerable, isolated and different, just at the age when the social pressure to conform is most intense.

12 Counters to these common factors which discourage girls from learning science and technology, and which frequently reappear in the literature, include girls-only science teaching, exercises to raise teachers' awareness of their sex-stereotyped attitudes, and courses which emphasise the social implications of science and technology. The 'Girls Into Science and Technology' project in Manchester schools sought to encourage girls to opt for science and technology courses through a variety of interventions. The project has generated a great deal of literature, describing both its successes and its failures to make an impact.

Computing and information technology education and training

13 There is some literature which concentrates on computing and information technology training/education and school-age girls. However, the bulk of the literature focuses on the problems faced by mature female students and returners.

14 Studies do show that, although initially positive towards computers, many girls reject education or careers in computing and information technology by their early teens. The close identification in many schools of computing and information technology teaching with mathematics and science is thought to alienate some girls. So too is the way in which boys monopolise often scarce computing equipment. Many girls come to believe that computers are basically 'toys for boys'.

15 Here again the attitudes of parents and teachers are held by some to be the key. They should ensure that girls get access to computers at home and school to the same extent as boys. A computer literacy project initiated by Croydon LEA sought to affect the attitudes not only of girls but also of teachers, parents and boys towards the participation of girls in computing and information technology education. The literature on this project describes how computing has been spread across the whole curriculum in order to break its links with mathematics and science. Croydon has also introduced girls-only computer clubs. The project has however been criticised for, among other things, failing to include programming as a basic component of computer literacy.

16 Schools can fail to interest girls in computing and information technology education and careers. Much evidence suggest that, by contrast, older females recognise that computing and information technology skills will give them increased employment opportunities. Some literature concentrates on the failure, for a number of reasons, of employers to encourage female employees to retrain; or of further education and MSC programmes to publicise the options available to those already in work.

17 It is further suggested that the growing number of mature females who do seek training in computing and information technology raise special issues for the further education system. Because many lack the appropriate formal entry qualifications for a number of computing and information technology courses, it is argued that further education institutions should show flexibility in this area, or else provide bridging or Access courses where these qualifications might be acquired. Age limits for courses is another area where further education institutions are urged to be flexible.

18 Regarding the way courses for older females should be designed, much of the literature in this area, as with computing courses in general, focuses on models which have developed outside the formal education system.

19 Some believe women's resource centres and explicitly feminist courses have been particularly successful in recruiting women into computing and information technology careers. These use women-only classes and women teachers whenever possible. The women's resource centres also concentrate on training which will quickly prepare women for success in the local job market, if possible in the better paying jobs not generally held by women.

20 In general, those who write about the education and training of mature females and returners in computing and information technology agree that the need is not only to teach the subjects, but also to build the confidence of learners so they can succeed both in the training and when they return to work. Confidence is built by introducing group work, individual tutoring, self-assessment, and the development of life skills. The review ends by noting the extent to which the relevant literature fails to raise the issues involved in recruiting other unmotivated and under-represented groups into computing and information technology, and not just women. It suggests that this absence is an important issue for future discussion and research.

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